



Cryogenic Propellant Storage and Transfer (CPST) Tour Stop*

**Building 401 - Small Multi-purpose Research Facility
(SMiRF)**

Presenters: Carol Ginty and Michael Meyer

February 4, 2013

* No formal presentation will be made. The CPST information will be communicated via posters and hardware located in the facility. Photographs of that material are attached for you review and approval. Parts of the facility will be closed for this tour.

Facility Hardware on Tour Stop



Hardware on Display in Facility



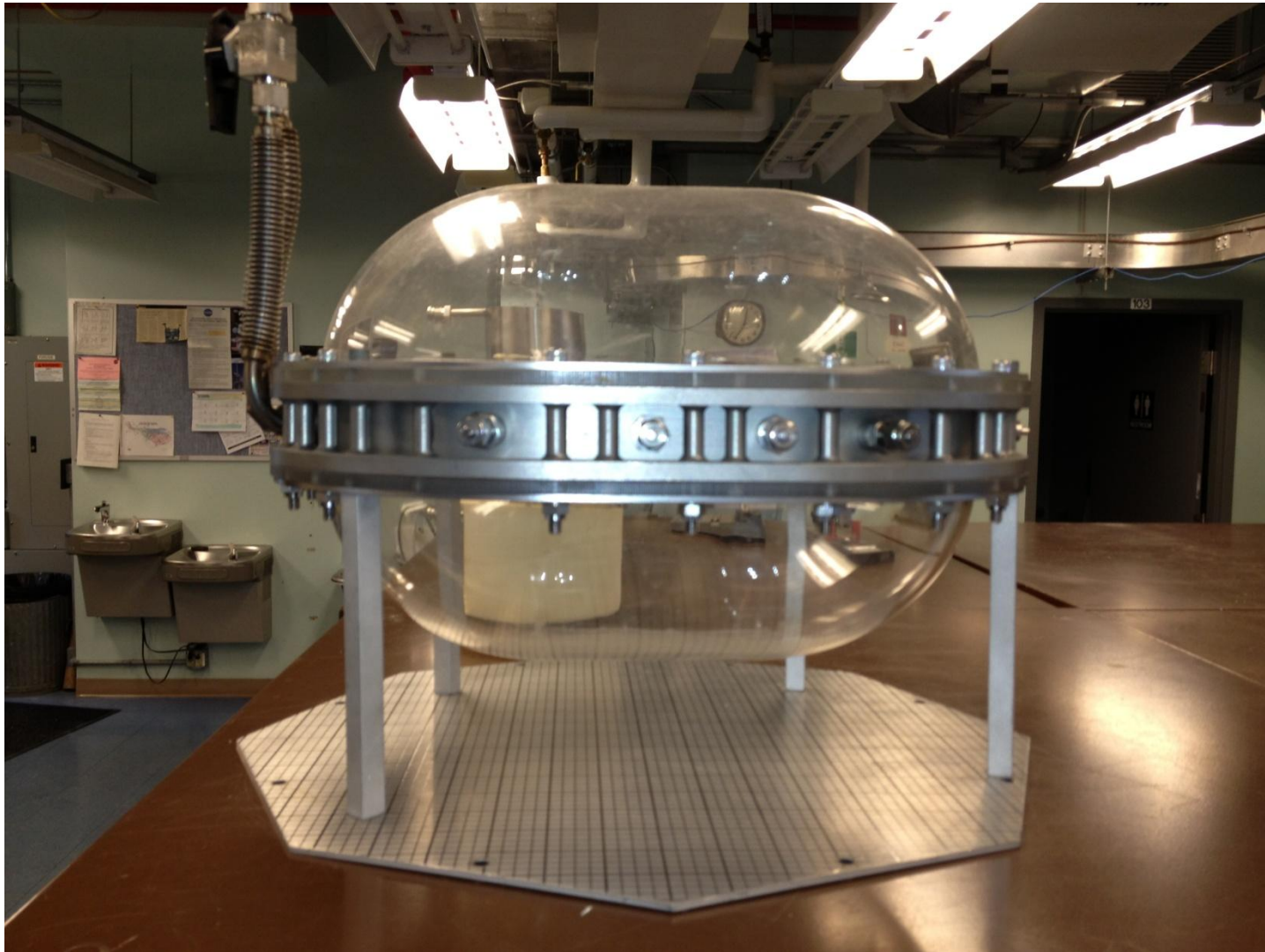
Hardware on Display in Facility



Hardware on Display in Facility



Hardware on Display in Facility



Hardware on Display in Facility



Poster to be Briefed on Tour

Cryogenic Propellant Storage and Transfer Technology Demonstration Missions

Goal: Advance cryogenic propellant system technologies for infusion into future extended in-space missions.

Objectives:

- Store cryogenic propellants in a manner that maximizes their availability for use regardless of mission duration
- Efficiently transfer conditioned cryogenic propellant to an engine or tank situated in a microgravity environment
- Accurately monitor and gauge cryogenic propellants situated in a microgravity environment

TRL Advance: 4/5 to 6

Team:
Project Manager: Susan Motil/GRC
Deputy Project Manager: Mark Hyatt/GRC
Principal Investigator: Michael Meyer/GRC
Chief Engineer: William Taylor/GRC

Center Support:
GRC (Lead)—Project Management, Systems Engineering, Safety and Mission Assurance, Integration and Test, Technology Development
Marshall Space Flight Center (MSFC)—Cryogenic Fluid System payload development
Goddard Space Flight Center (GSFC)—Spacecraft bus and flight operations
Kennedy Space Center (KSC)—Launch vehicle and ground operations

NRC: Technology is close to a "tipping point," and NASA should perform on-orbit flight testing and flight demonstrations to establish technology readiness.

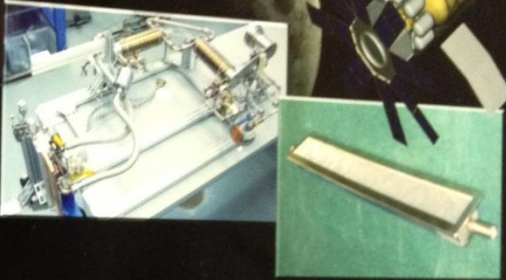
Infusion Targets: Cryogenic Propulsion Stage, Depots

Project Initiated: 5/2011

Project Key Milestones:


- SRR: 1st Qtr FY13
- PDR: 2nd Qtr FY14
- CDR: 2nd Qtr FY15
- SAR: 3rd Qtr FY16

Flight Hardware Available: 3rd Quarter FY16
Launch Date: FY16 (notional, 4th Quarter)
Mission Duration: 6 months




Poster to be Briefed on Tour

Cryogenic Propellant Liquid Acquisition Devices



Mirror
LAD Screen
Fiber Optic Light


LAD test article in cryogenic dewar



SEM photograph of LAD screen

Technology

For propellant storage systems operating in low gravity, fluid transfer is driven largely by surface tension forces. Liquid Acquisition Devices (LADs) are required in these systems to assure single phase fluid transfer. LADs designed for cryogenic propellants will enable use of these non-toxic "green" propellants in next generation vehicles.



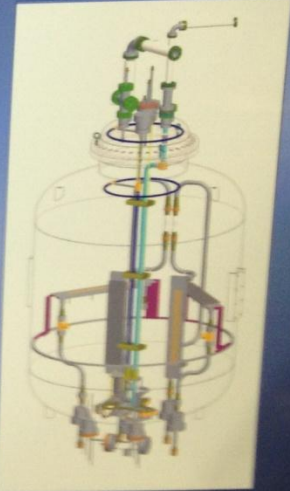
LOX test tank for testing LADs at high pressures (1.7 Mpa)

Methodology

NASA has pursued a bottoms-up approach to cryogenic LAD development. These LADs are fine mesh screens that work by taking advantage of surface tension forces. LADs are characterized by their "bubble point" – the differential pressure that allows a vapor bubble to pass through the screen. NASA has systematically conducted research to increase the TRL for LADs. Specific milestones completed to date include:

- Characterizing LAD bubble points in Isopropyl alcohol
- Bubble point testing with cryogenic fluids -
 - Liquid Nitrogen (LN_2)
 - Liquid Oxygen (LOX)
 - Liquid Hydrogen (LH_2)
 - Liquid Methane (LCH_4)
- Characterizing high flow rate LOX through LAD channels
- Investigating the operation of LADs in high pressure LOX

Possible future activities include testing LADs in high pressure LCH_4 , and including LADs in a cryogenic fluid integrated system test.



Drawing of a high flow LOX LAD test configuration at NASA Glenn Research center

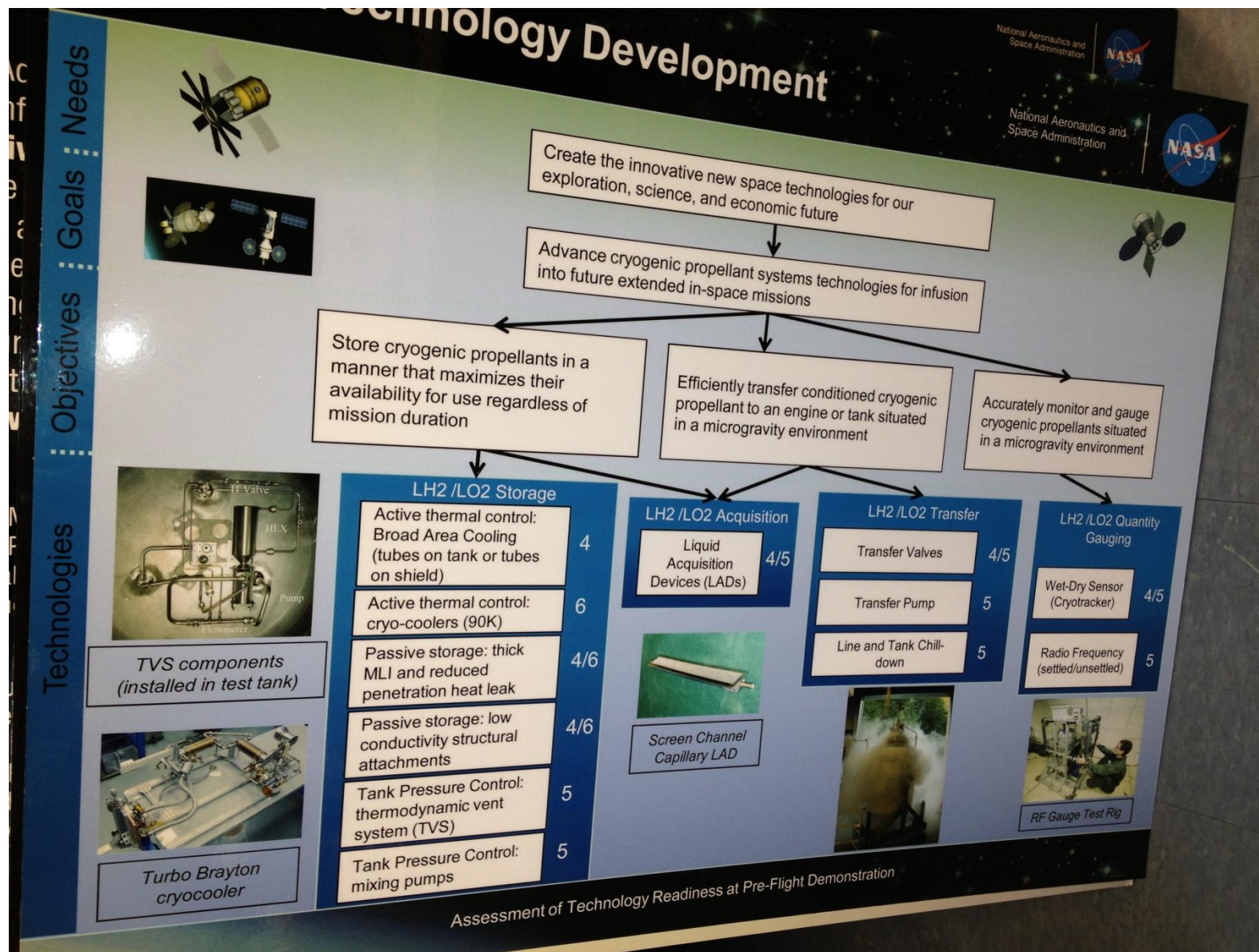
23000 Brookpark Rd. Cleveland, OH

NASA Glenn Research Center

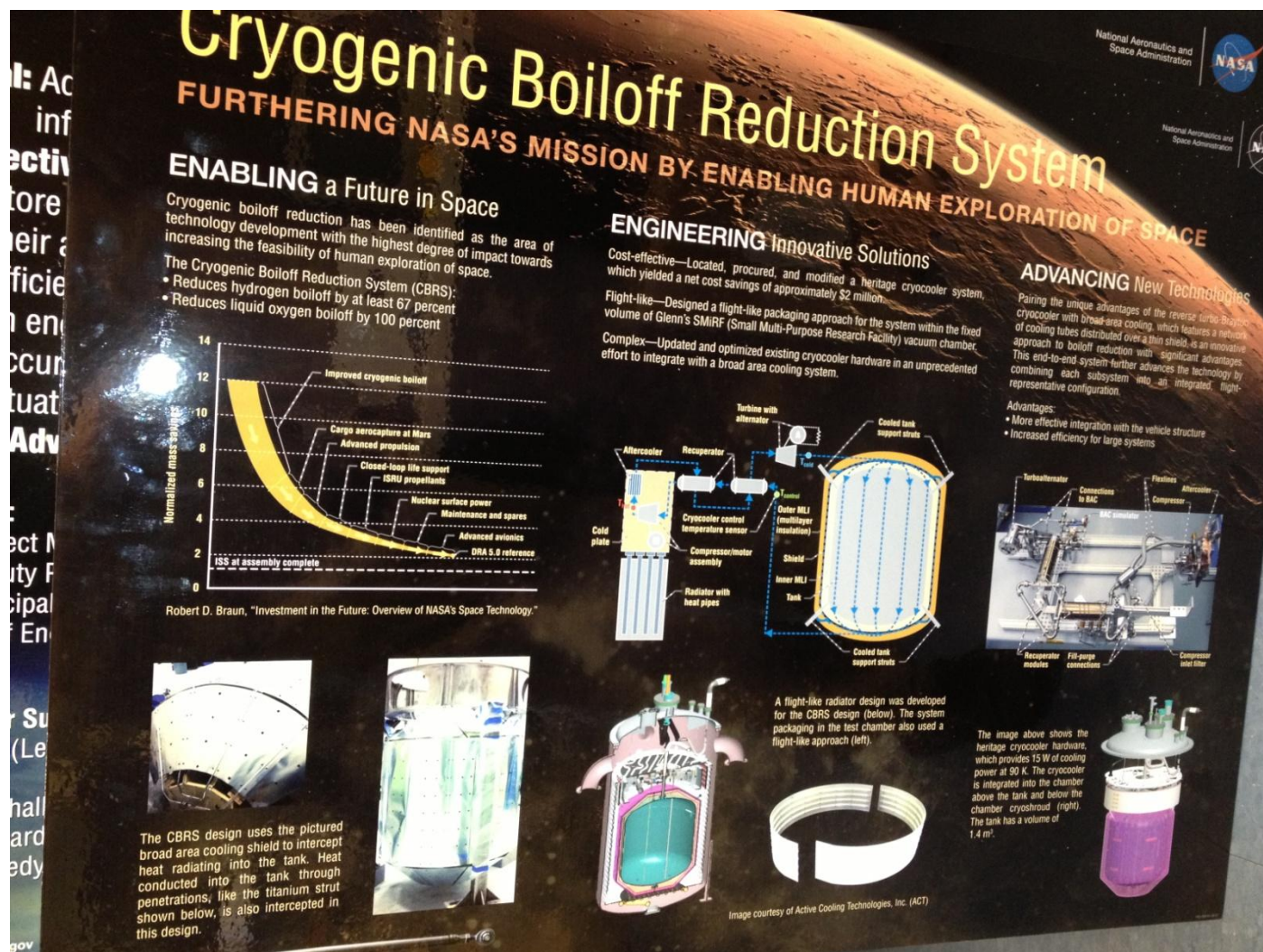
Poster to be Briefed on Tour



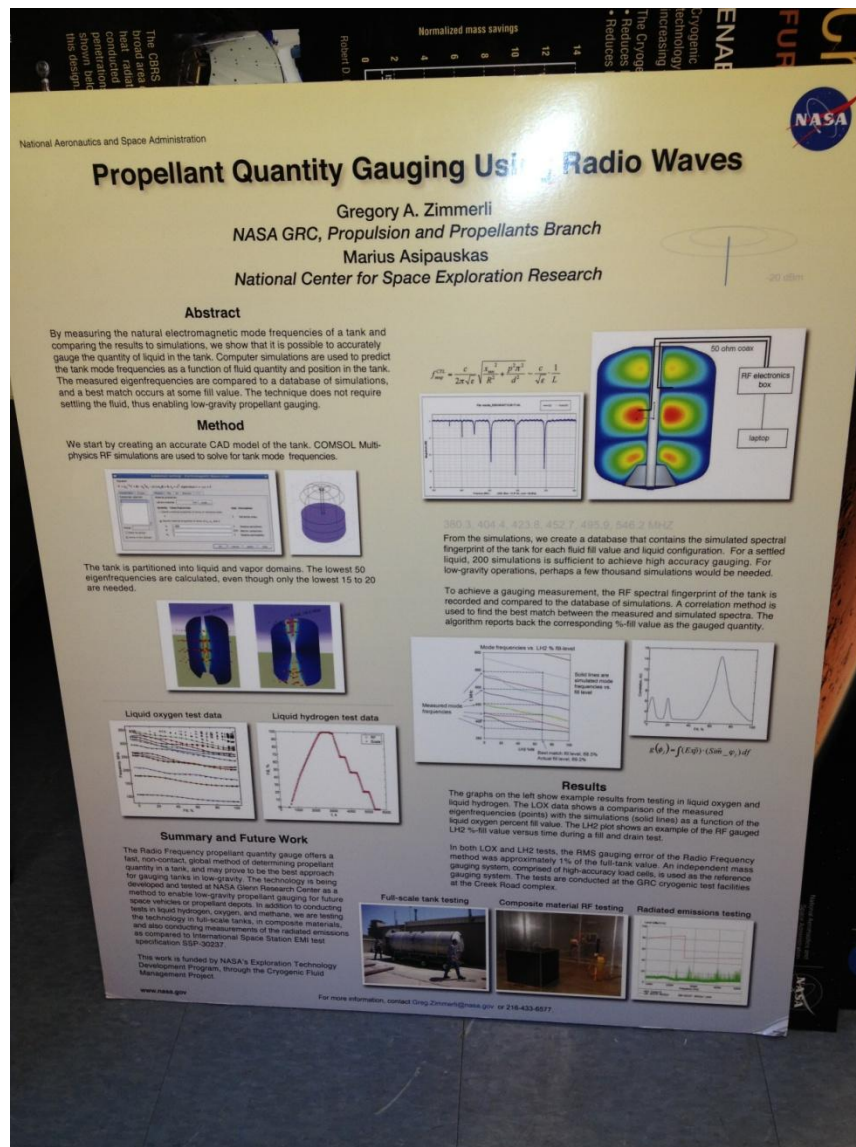
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